



## RESULTS OF THE ECO-COMPASS EU-CHINA PROJECT

Funchal, September 2019

**ICSI 2019**

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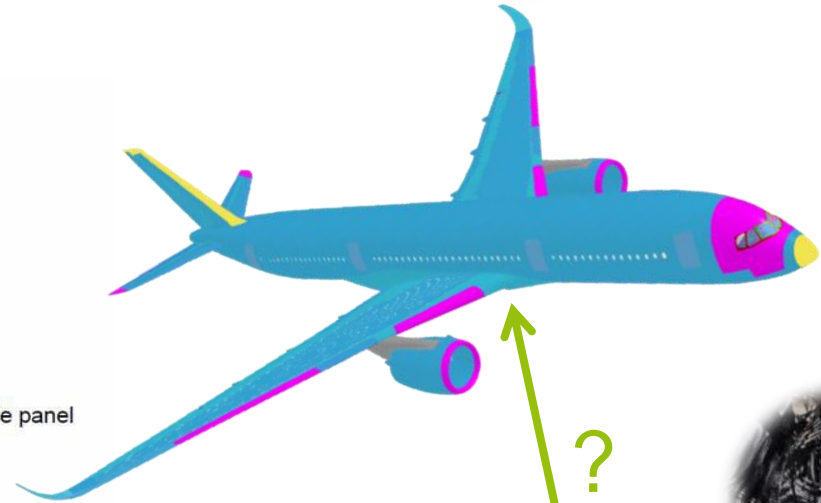
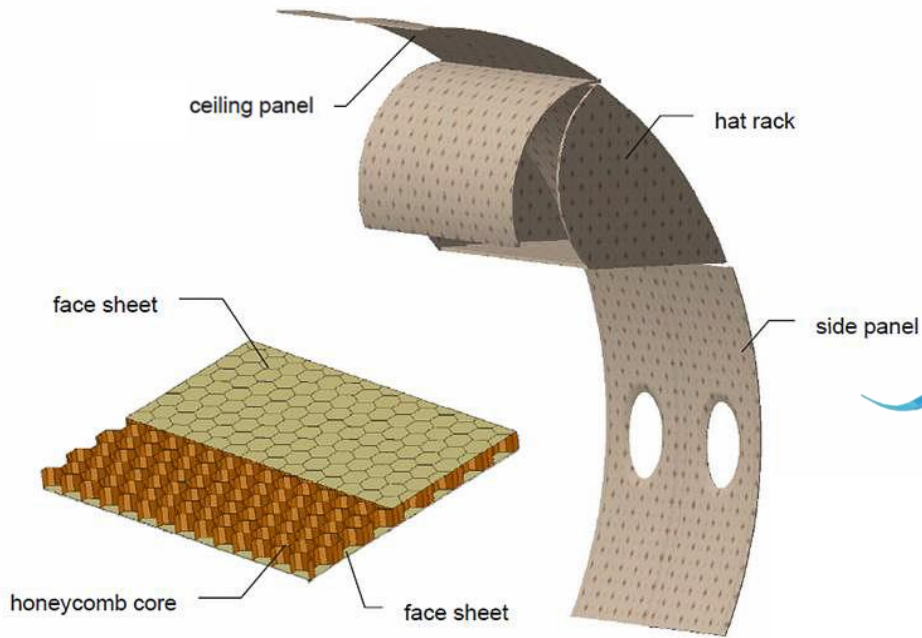
*This project has received funding from:*

*- The European Union's Horizon 2020 research and innovation programme under grant agreement No 690638*

*- The Ministry for Industry and Information of the People's Republic of China under grant agreement No [2016]92*



# Background



- Natural Fibres?
- Bio-based resins?
- Recycled fibres?
- Multifunction?



# ECO-COMPASS



## Ecological and Multifunctional Composites for Application in Aircraft Interior and Secondary Structures

- ▶ Cooperation of Chinese and European partners
- ▶ 2016 – 2019
- ▶ Identification of applications for eco- and multifunctional composites
- ▶ Development, characterization and simulation of eco-materials to give a broad overview of the possibilities in aviation with leverage to other transport sectors like automotive and railway.
- ▶ Application / Demonstrators
- ▶ Life Cycle Assessment (LCA)

# ECO-COMPASS



EUROPEAN PARTNERS  
FROM 6 COUNTRIES

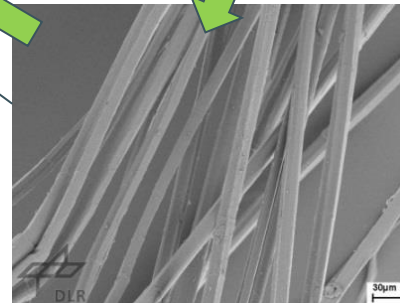
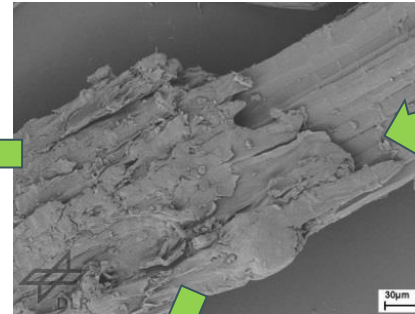


CHINESE PARTNERS

[www.ECO-COMPASS.eu](http://www.ECO-COMPASS.eu)



“bio-based”



# ECO-COMPASS RESULTS

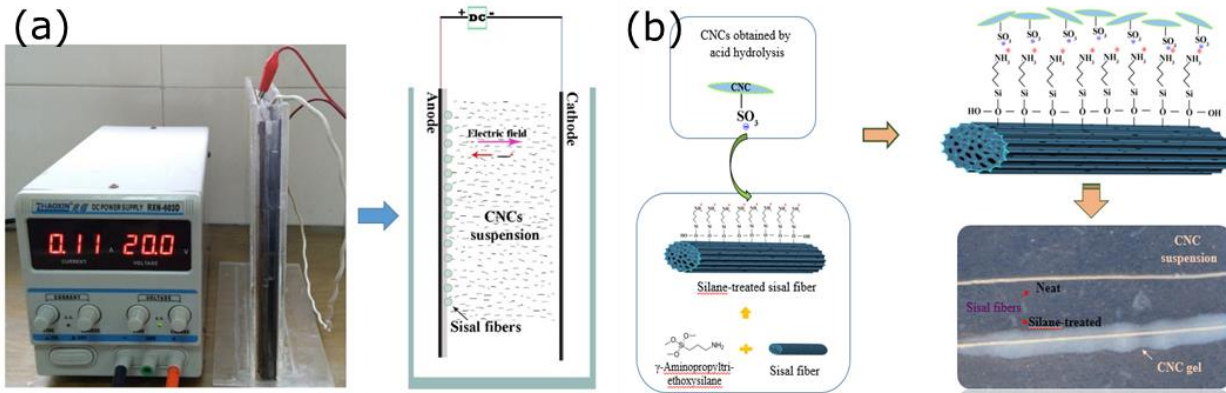
EU & China

September 2019



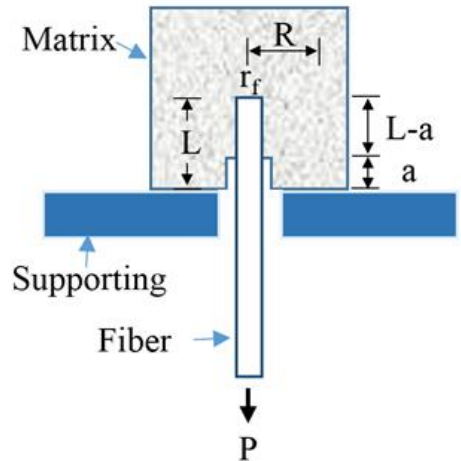
# ECO-COMPASS Results

- Improvement of fibre properties

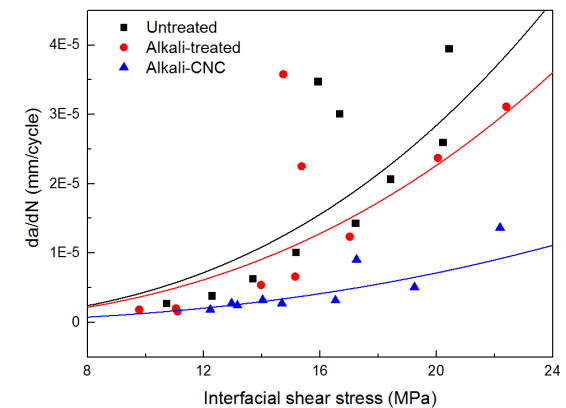


Modification of sisal fiber with CNC by (a) electrophoresis, (b) electrostatic adsorption

Treatment	Diameter ( $\mu\text{m}$ )	Tensile strength (MPa)	Young's Modulus (GPa)
Untreated	173.3 (31)	529.9 (102)	13.6 (2.9)
CNC-treated	175.3 (32)	511.5 (97)	14.4 (3.3)
Alkali-treated	142.6 (18)	692.8 (92)	18.8 (3.0)
Alkali-CNC-EPD	156.4 (23)	614.9 (73)	22.0 (3.1)
Alkali-CNC-ESA	150.2 (20)	716.6 (110)	21.0 (2.6)



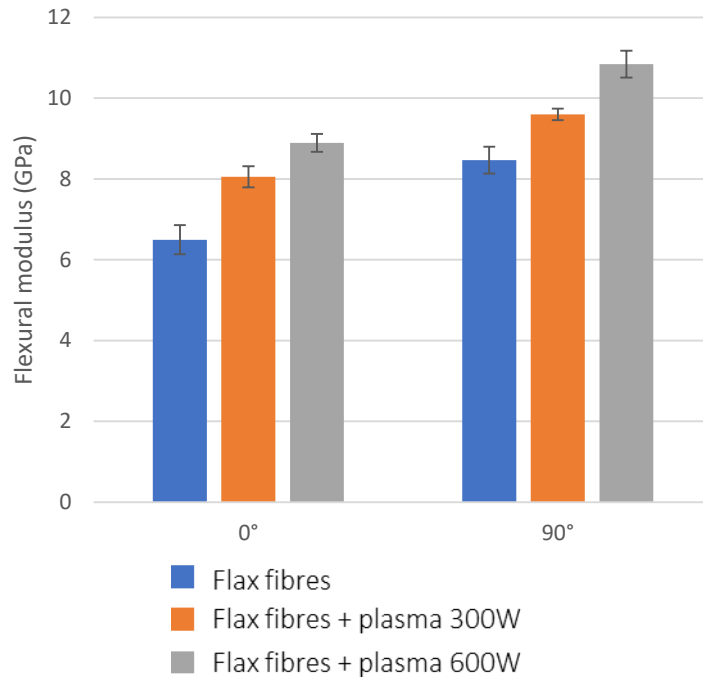
dynamic interface fatigue pull-out test



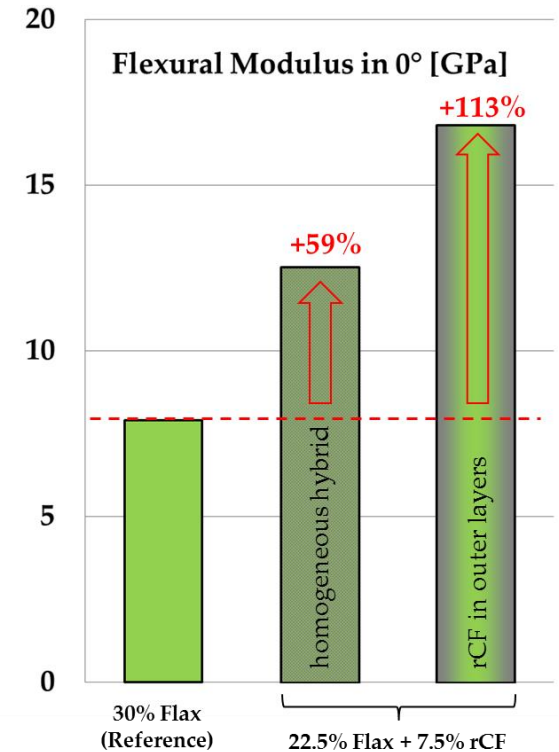
# ECO-COMPASS Results



Plasma treatment (rCF, flax)



Hybrid nonwoven (rCF, flax)



Techtextil 2019 forum, TTF 9 - sustainable fibre innovations & applications: "Plasma treatment of bio-based and recycled fibres for eco-composites", R Garcia, LEITAT

Aerospace 2018, 5(4), 107; <https://doi.org/10.3390/aerospace5040107>  
Aerospace 2018, 5(4), 120; <https://doi.org/10.3390/aerospace5040120>





# ECO-COMPASS

## bio-bases resins



Epoxidized natural oils

Rosin

Saccharides

Natural polyphenols

September 2019



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## Results

Rosin-based curing agent epoxy resin

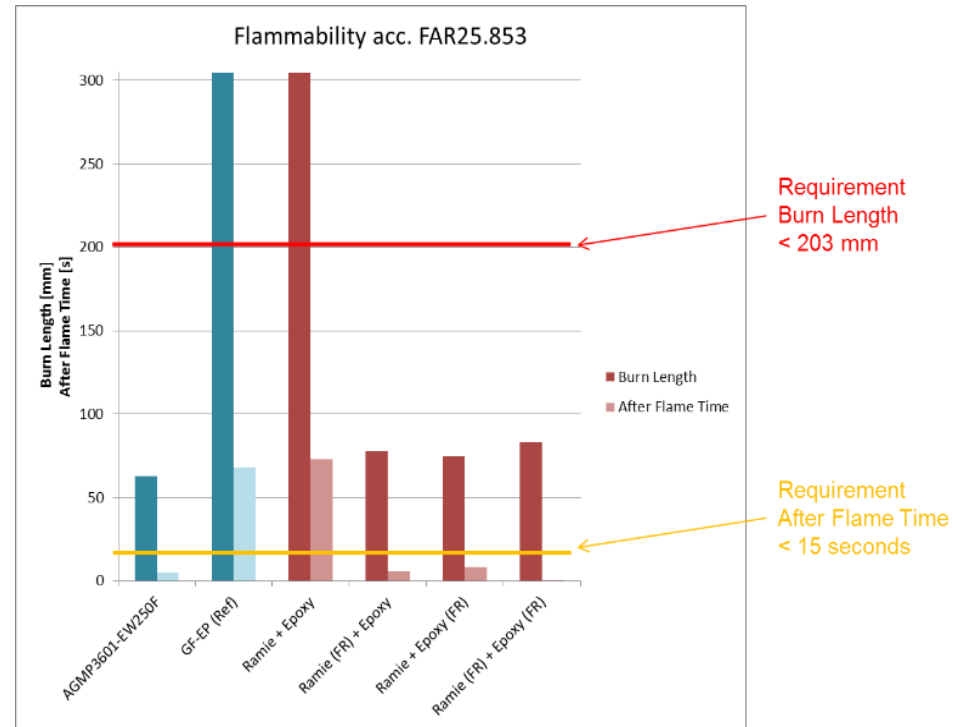
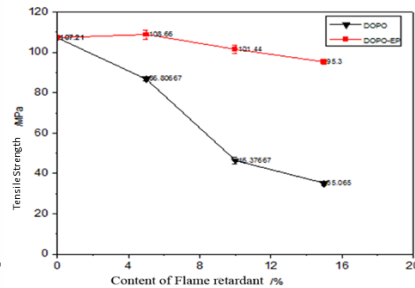
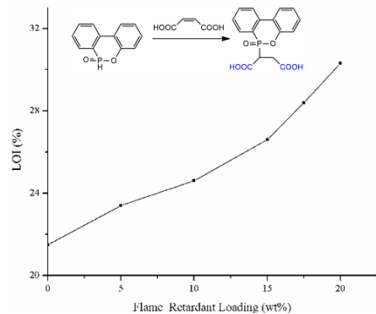
Property and test condition		Unit	Reference <sup>1</sup>	Test result	Standard
Tensile strength warp	RT/dry	MPa	≥500	707	ASTM D 3039
Tensile modulus warp	RT/dry	GPa	65±8	62.3	
Tensile strength weft	RT/dry	MPa	≥500	557	
Tensile modulus weft	RT/dry	GPa	65±8	60.9	
Compression strength warp	RT/dry	MPa	≥300	509	ASTM D6641
Compression modulus Warp	RT/dry	GPa	58±8	61.2	
Compression strength Weft	RT/dry	MPa	≥280	362	
Compression modulus weft	RT/dry	GPa	57±8	57.7	
Bending strength warp	RT/dry	MPa	≥650	883	ASTM D 790
Bending modulus warp	RT/dry	GPa	58±8	56.8	
Short bean shear strength	RT/dry	MPa	≥50	55.7	ASTM D2344
In plane shear strength	RT/dry	MPa	≥45	72.6	ASTM D3518
In plane shear modulus	RT/dry	GPa	3.5±1	3.84	

<sup>1</sup> A commercial product



# ECO-COMPASS Results

- Flammability



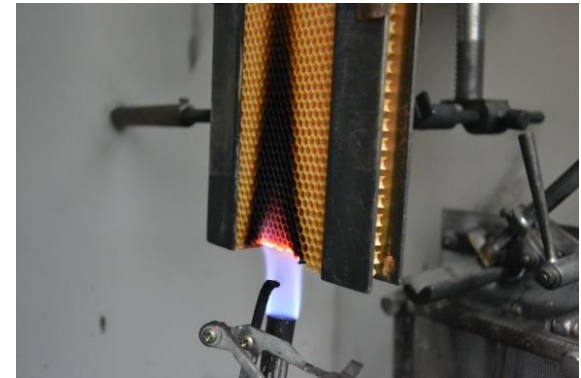
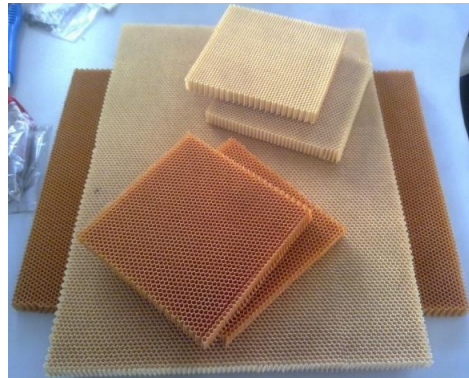
# ECO-COMPASS

## Results



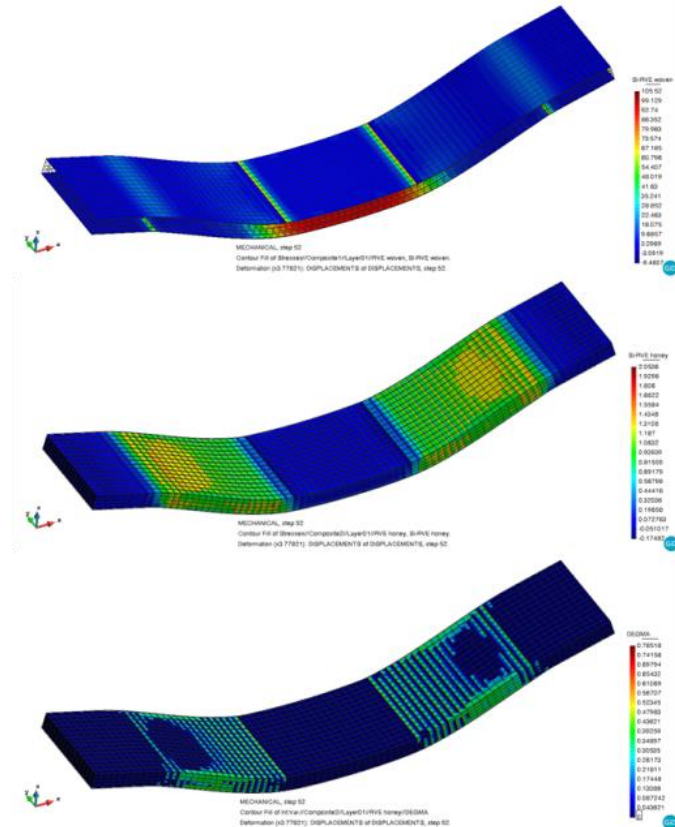
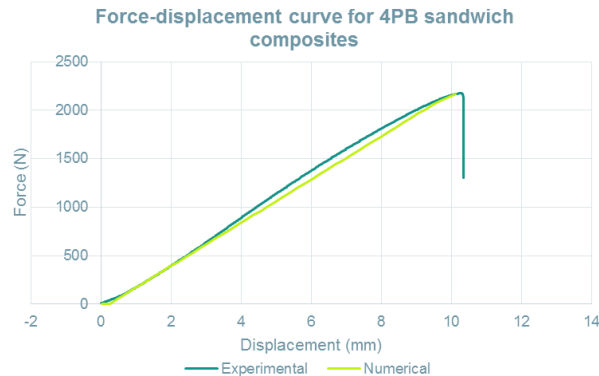
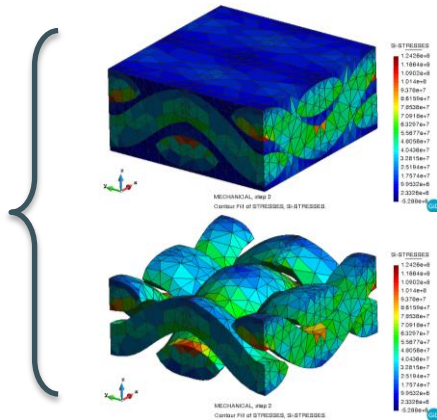
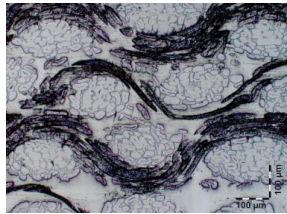
AGMH-1 “Green Honeycomb” is made of plant fiber hybrid paper containing 20% plant fibers.

Items	Compression strength, MPa	Longitudinal shear strength, MPa	Transversal shear strength, MPa	Longitudinal shear modulus, MPa	Transversal shear modulus, MPa
Nomex, I	1.24	1.0	0.55	32.5	19.5
Nomex, II	1.64	1.07	0.58	36	19
GREEN Honeycomb	1.78	1.16	0.75	43.2	29.3





# ECO-COMPASS Results

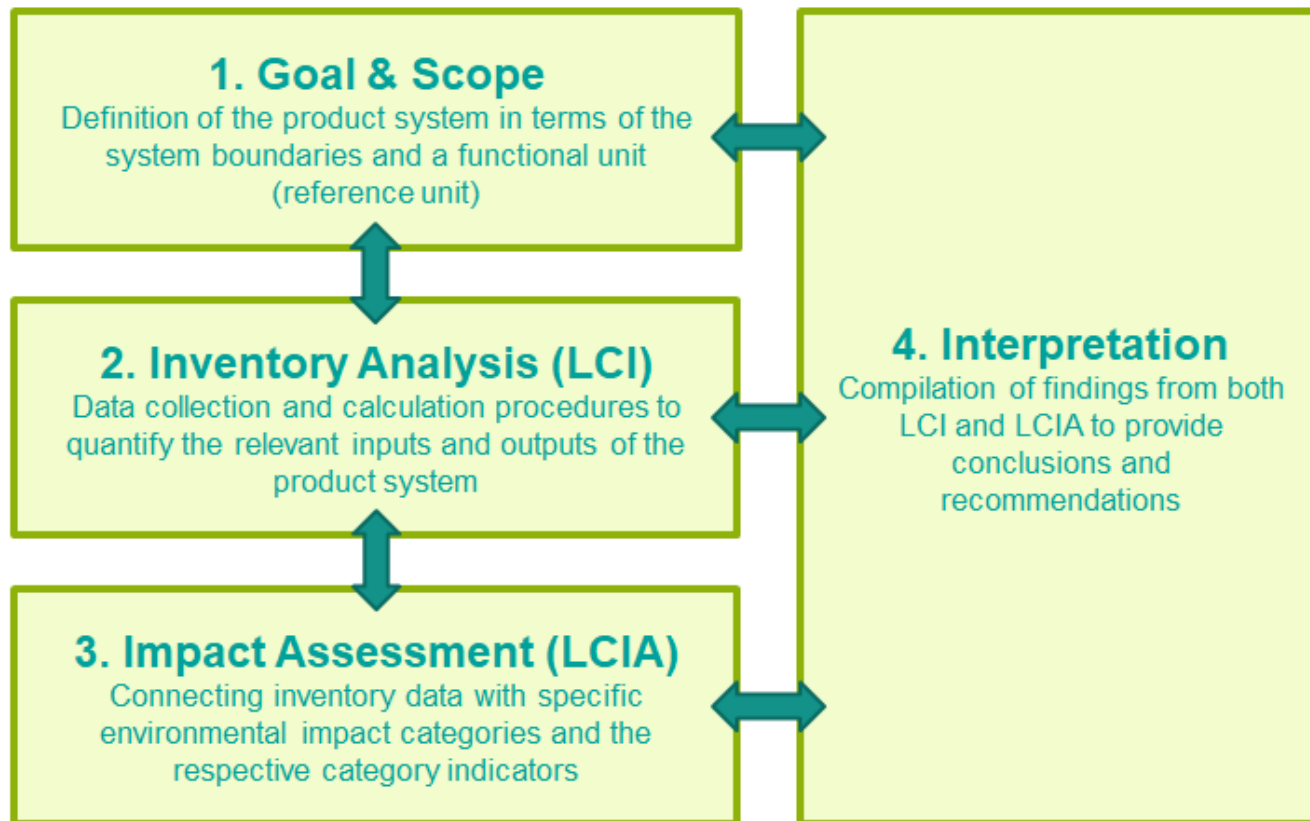


Composite Structures 131 (2015): 707-719. DOI: 10.1016/j.compstruct.2015.06.006  
Composite Structures 206 (2018): 215-233. DOI: 10.1016/j.compstruct.2018.08.022



# ECO-COMPASS

## LCA



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## Potential Gaps and Challenges



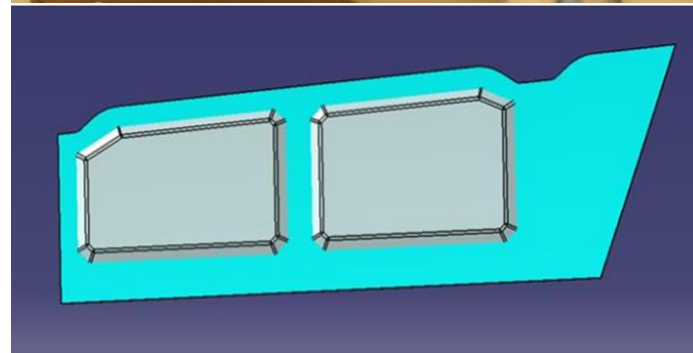
- Fire performance, especially the Heat Release of NFRP and (bio-based) epoxy resins.
- Long term behaviour
- Upscaling of fibre modification technologies
- Assessment of potential environmental impacts of treatments and processes to improve properties of eco-composites

# ECO-COMPASS

## Demonstrators



*Airbus*



*AVIC*





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THANK YOU FOR YOUR ATTENTION.

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